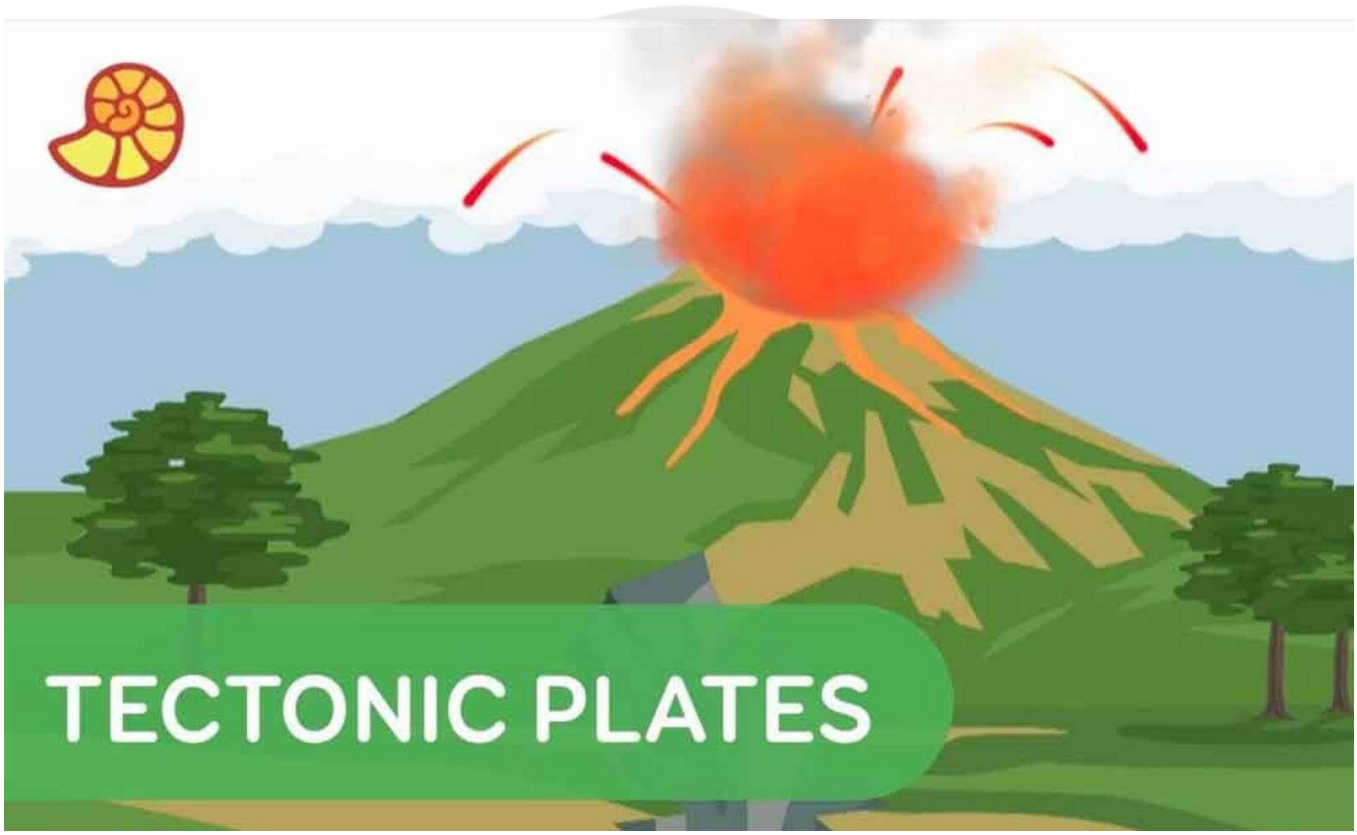
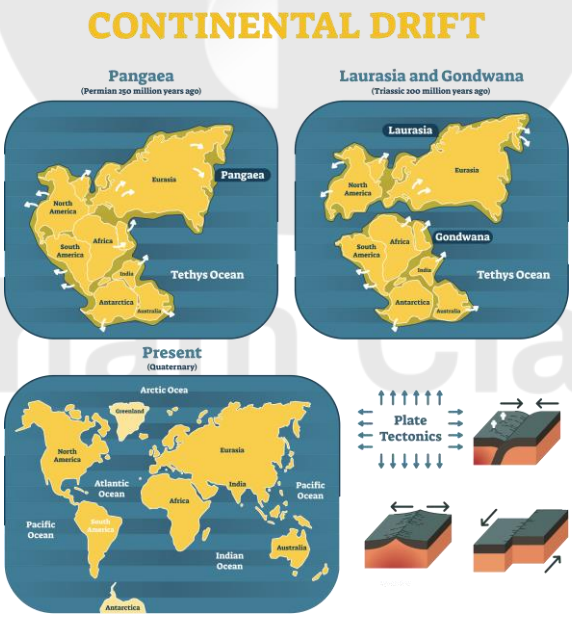

TECTONIC PLATES

Tectonic Plates

- A tectonic plate (also called lithospheric plate) is a massive, irregularly-shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.
- The lithosphere includes the crust and top mantle with its thickness range varying between 5-100 km in oceanic parts and about 200 km in the continental areas.
- The concept of Tectonic Plates was first introduced in 1967.
- A tectonic plate may be a continental plate or an oceanic plate, depending on which of the two occupies the larger portion of the plate.
- The Pacific plate is largely an oceanic plate whereas the Eurasian plate is a continental plate.

Historical Background

- Continental drift theory is given by Alfred Wegener in 1912 put forth a comprehensive argument in the form of the Continental Drift Theory which stated that all existing continents on earth were in the form of a supercontinent called PANGAEA and the mega ocean was called PANTHALASSA about 200 million years ago.
- Pangaea first broke into two continental masses as Laurasia(northern part) and Gondwanaland(southern part) which further continued to break into smaller continents that exist today.



Convection Current Theory

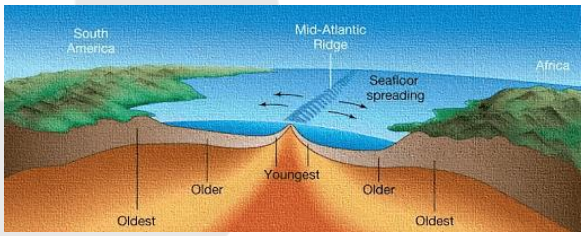
- Convection Current Theory was postulated by Arthur Holmes in the 1930s which discussed the possibility of convection currents operating in the mantle portion generated due to radioactive elements causing thermal differences in the mantle portion.
- This theory made an attempt to explain the reason behind the movement of different continents in different directions for which Alfred Wegener could not give a rational explanation in continental drift theory.

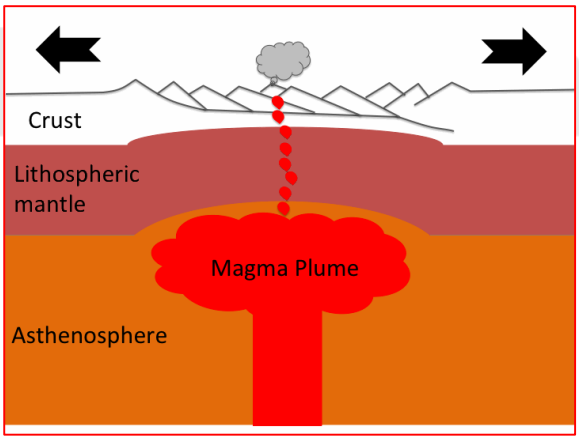
- The term tectonics comes from the Greek word tektonikos, which means "building or construction," and refers to the deformation of the earth's crust caused by internal forces.
- The theory of plate tectonics identifies 7 major and 20 minor types of lithospheric plates.
- These plates are continuously in motion with respect to each other.

- The oceanic plates are thinner and mostly made up of Simatic crust, whereas the continental plates are heavier and mostly made up of Sialic crust.
- Seafloor spreading, volcanic eruptions, crustal deformation, mountain construction, and continental drift all occur along the plate borders.

Seafloor Spreading

- Seafloor spreading is the process of magma welling up in the rift as the old crust pulls itself in opposite directions.
- Cold seawater cools the magma, creating a new crust.
- The upward movement and eventual cooling of this magma has created high ridges on the ocean floor over millions of years.
- The East Pacific Rise is a site of major seafloor spreading in the Ring of Fire





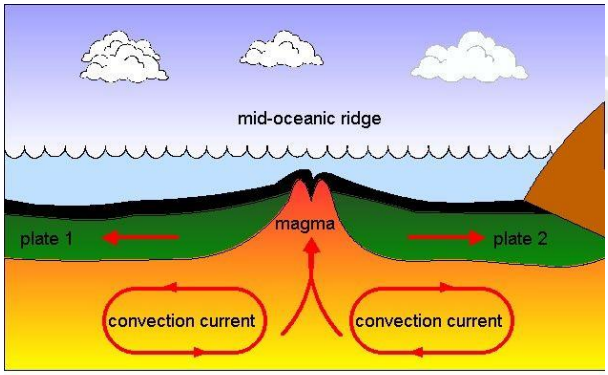
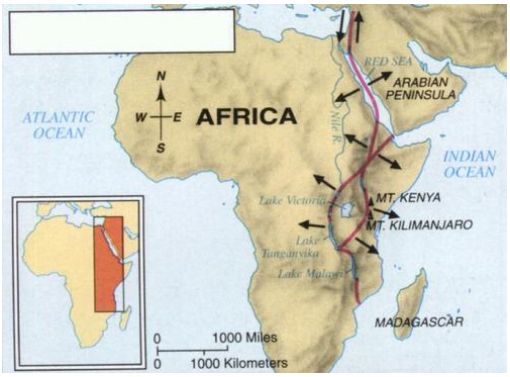
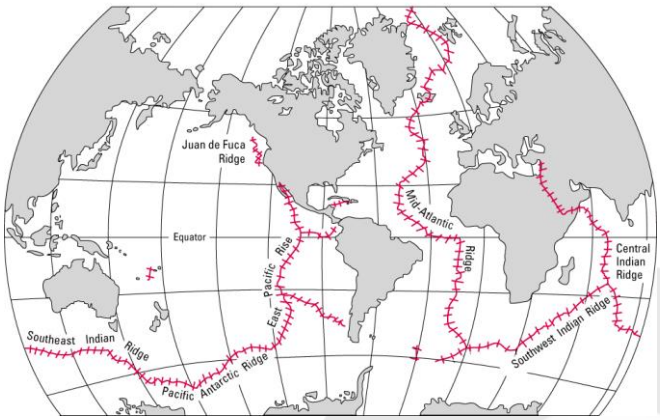
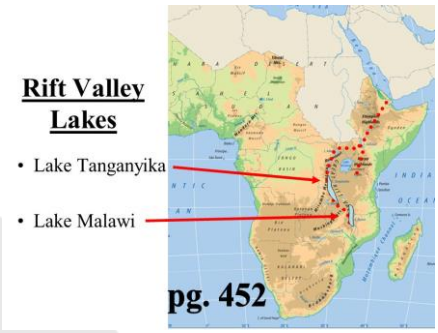


Plate 1 and plate 2 move apart. Magma rises, cools and solidifies forming new igneous rock. This is sea-floor spreading and is a constructive plate boundary.

If the boundary is found between two continental plates you are left with a rift valley. ... If two oceanic plates begin moving away from each other it creates a mid-oceanic ridge.



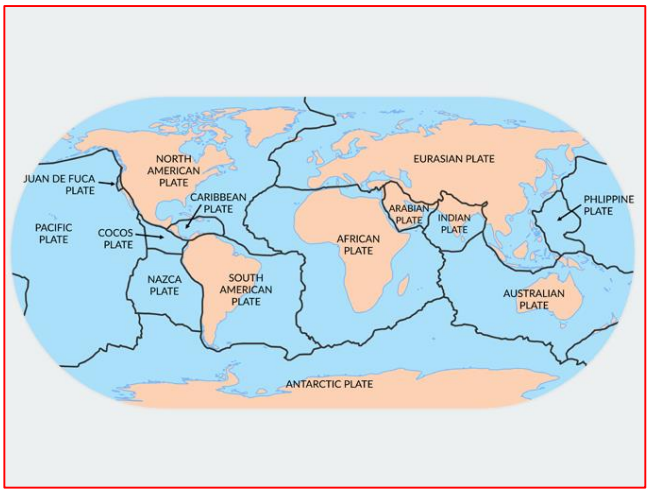




	Continental Drift	Sea Floor Spreading	Plate Tectonics
Explained by	Put forward by **Alfred Wegener** in the 1920s	**Arthur Holmes** explained Convectional Current Theory in the 1930s.Based on convection current theory, **Harry Hess** explained See Floor Spreading in the 1940s	In 1967, McKenzie and Parker suggested the theory of plate tectonics. Morgan later outlined the theory in 1968
Theory	Explains the Movement of Continents only	Explains the Movement of Oceanic Plates only	Explains the Movement of Lithospheric plates that include both continents and oceans.

Major tectonic plates

- Antarctica and the surrounding oceanic plate – (Surrounded by divergent boundaries.)
- North American plate – (shifting westwards, velocity 4-5 cm/year. It is half oceanic—half continental)
- South American plate – (shifting westwards, Half continental — half oceanic. 3-4 cm/year)
- Pacific plate – (Truly oceanic plate. Shifting NW 2- 3cm/year)
- India-Australia-New Zealand plate
- Africa with the eastern Atlantic floor plate
- Eurasia and the adjacent oceanic plate – (mostly continental, shifting eastwards. Velocity -2-3cm/year)



Movement of Plates

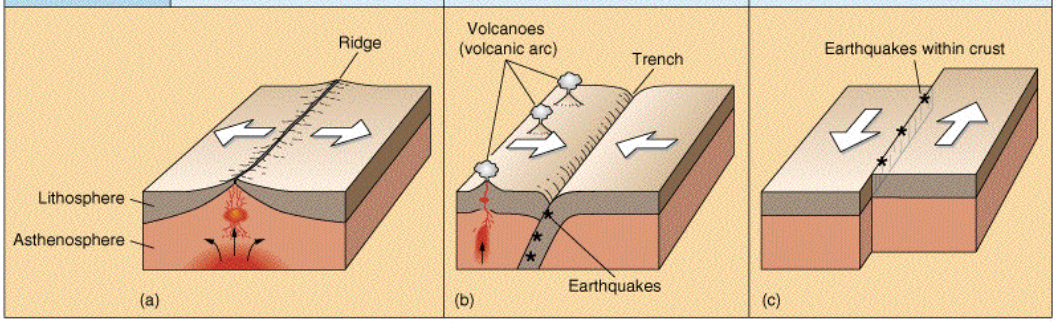
- The tectonic plates are not fixed but constantly move horizontally over the Asthenosphere as rigid units.
- Sometimes these plates collide, move apart, or slide next to each other which leads to Earthquakes or Volcanic Eruptions.

- Asthenosphere:
- It is the zone of Earth's mantle that lies just beneath the lithosphere and is believed to be much hotter and more fluid than the lithosphere.
- The asthenosphere extends from about 100 km (60 miles) to about 700 km (450 miles) below Earth's surface.

- The Arctic Ridge has the slowest rate (less than 2.5 cm/yr), and the East Pacific Rise, in the South Pacific (about 3,400 km west of Chile) has the fastest rate (more than 15 cm/yr).

- Convergent, where plates move into one another.
- Divergent, where plates move apart.
- Transform, where plates move sideways in relation to each other.

Type of Margin	Divergent	Convergent	Transform
Motion	Spreading	Subduction	Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Topography	Ridge/Rift	Trench	No major effect
Volcanic activity?	Yes	Yes	No

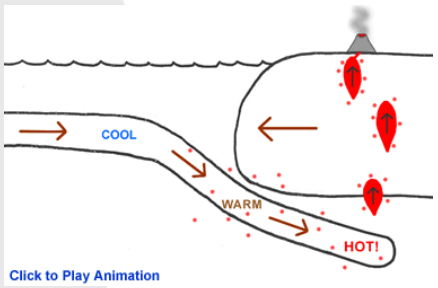


Divergent Boundaries

- A divergent boundary is formed by tectonic plates pulling apart from each other. They are known as constructive boundaries.
- Divergent boundaries are the site of seafloor spreading and rift valleys.
- At divergent boundaries in the oceans, magma from deep in the Earth's mantle rises toward the surface and pushes apart two or more plates. Mountains and volcanoes rise along the seam. The process renews the ocean floor and widens the giant basins.
- The best-known example of divergent boundaries is the Mid-Atlantic Ridge where the American Plates are separated from the Eurasian and African Plates.

Convergent Plate Boundaries:

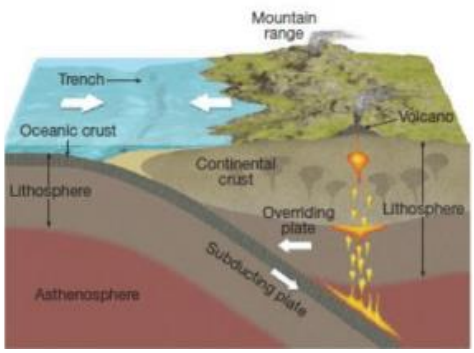
- At a convergent boundary, plates collide and as such are sometimes called “destructive” boundaries because they result in removal or compression of the surface crust. Convergent plate boundaries are responsible for some of the most massive and spectacular of earthly landforms: major mountain ranges, volcanoes, and oceanic trenches.
- The three types of convergent boundaries are –
- Oceanic–continental convergence,
- Oceanic–oceanic convergence,
- Continental–continental convergence.



- When continental and oceanic plates collide, the oceanic plate, which is thinner and denser, is pushed aside by the continental plate, which is thicker and less dense.
- In a process known as "subduction," the oceanic plate is driven down into the mantle.
- The oceanic plate is thrust into higher temperature environments as it lowers.
- Materials in the subducting plate begin to approach their melting temperatures at a depth of about 100 miles (160 kilometres), and partial melting begins.
- The most active example of continental convergent plate boundaries is the Himalayan Mountain Range.
- Around 55 million years ago, India and Asia collided, forming the Himalayas, the world's largest mountain range. The Indian and Eurasian plates are colliding right now.

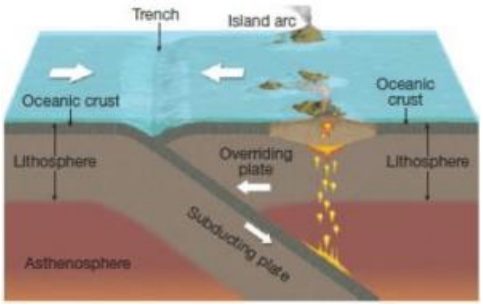
Oceanic–Continental Convergence

- Because the oceanic lithosphere includes dense basaltic crust, it is denser than the continental lithosphere, and so the oceanic lithosphere always under-rides the continental lithosphere when the two collide.
- The dense oceanic plate slowly and inexorably sinks into the asthenosphere in the process of subduction.



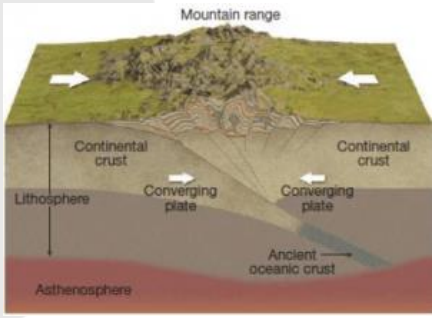
Oceanic–Oceanic Convergence

- If the convergent boundary is between two oceanic plates, subduction also takes place. As one of the oceanic plates subducts beneath the other, an oceanic trench is formed, shallow and deep-focus earthquakes occur and volcanic activity is initiated with volcanoes forming on the ocean floor.
- With time, a volcanic island arc (such as the Aleutian Islands and the Mariana Islands) develops; such an arc may eventually become a more mature island arc system (such as Japan and the islands of Sumatra and Java in Indonesia are today).



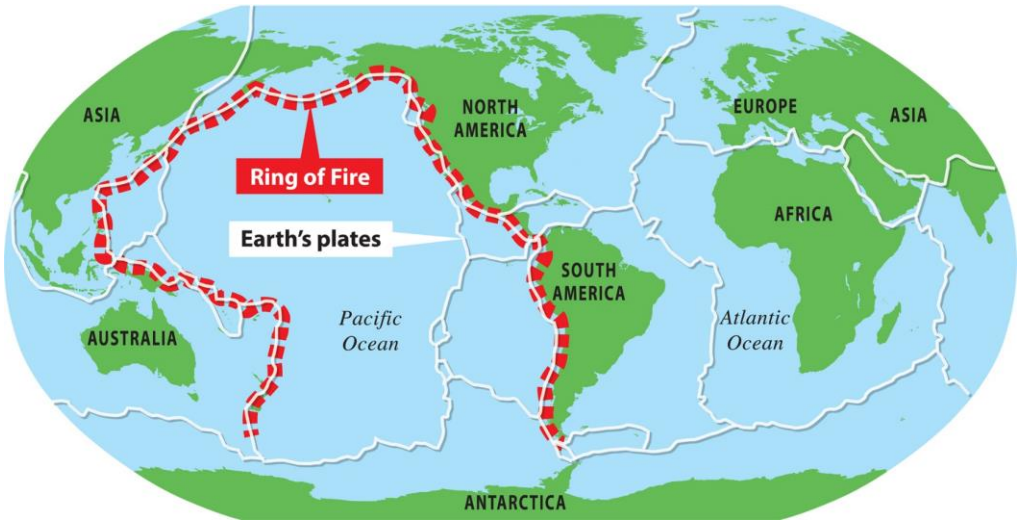
Continental-Continental Convergence

- Where there is a convergent boundary between two continental plates, no subduction takes place because continental crust is too buoyant to subduct. Instead, huge mountain ranges, such as the Alps, are built up. The most dramatic present-day example of the continental collision has resulted in the formation of the Himalayas.



Transform Plate Boundaries:

- Two plates slide past each other in this type of interaction, and no new landforms are created or destroyed; only the present landform is deformed.
- The best example of a transcurrent edge on continents is the San Andreas Fault (Silicon Valley sits dangerously close to the faultline) on the western coast of the United States.



The significance of Plate Tectonics

- Almost all major landforms formed are due to plate tectonics.
- New minerals are thrown up from the core with the magmatic eruptions.
- Economically valuable minerals like copper and uranium are found near the plate boundaries.
- From the present knowledge of crustal plate movement, the shape of landmasses in the future can be predicted.
- For instance, if the present trends continue, North and South America will separate. A piece of land will separate from the east coast of Africa. Australia will move closer to Asia.

MCQ

Question: With reference to plates and plate tectonics, Consider the following statements:

The lithosphere consists of only the upper crust.
The Pacific plate is the only major plate that is completely oceanic.
The theory of Plate tectonics propounded that there was a supercontinent called Pangaea and a superocean called Panthalassa.
Which of the above statements is/are NOT correct?
(a) 2 and 3 only
(b) 1 only
(c) 1 and 3 only
(d) 3 only

Question: Consider the following statements regarding Plate tectonics.

The driving force behind plate tectonics is convection in the mantle.
At transform boundaries, the crust is neither produced nor destroyed as the plates slide horizontally past each other.
The Mid-Atlantic Ridges are a good example of a convergent boundary.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) All of the above

The type of plate- boundary interaction along the Himalayas is known as?

(a) Continent-continent convergence.
(b) Divergent boundary
(c) Transform boundary
(d) Ocean-continent convergence

Which of the following earthquake waves is first recorded on the Seismograph?
(a) P-waves
(b) Rayleigh waves
(c) S-waves
(d) Love waves

Consider the following statements regarding plate boundaries
1. In Transform faults neither crust is created or destroyed.
2. Mid Atlantic ridge is best example of divergent boundaries.
Select the correct answer from the following codes
a. Only 1
b. Only 2
c. Both 1 and 2
d. Neither 1 nor 2

Question	Answer
1	C
2	A
3	A
4	A
5	C